Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36

LA-UR--86-3777

DE87 002920

TITLE: X-RAY SAFETY AT THE LOS ALAMOS NATIONAL LABORATORY

AUTHOR(S): Jose A. Gutierrez

SUBMITTED TO: 20th Midyear Topical Symposium of the Health Physics Society

DISCLAIMER

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FORM NO 836 R4
ST NO 2629 5/81

X-RAY SAFETY AT THE LOS ALAMOS NATIONAL LABORATORY

J. A. Gutierrez
Los Alamos National Laboratory
P.O. Box 1663, M.S. K487
Los Alamos, New Mexico 87545

ABSTRACT

An organized and structured safety program for x-ray generating devices was initiated in October, 1979. An X-ray Device Control Office was established to manage the program that currently oversees the activities of 201 x-ray generating devices and to provide SOP reviews, perform shielding calculations, and provide training for both the operators and health physics x-ray device surveyors. The new program also establishes controls for procurement of new equipment, requires the writing of Standard Operating Procedures, requires training for operators and provides routine and non-routine safety inspections of x-ray generating devices. Prior to this program going into effect, the Laboratory had recorded nine documented x-ray related exposure accidents. Since then, there have been none. Program elements and experiences of interest to other x-ray device users are discussed.

INTRODUCTION

X-ray generating devices have been surveyed using varying methods at Los Alamos National Laboratory (LANL) since 1952. Initially, a very informal one page survey form was used. The same survey form sufficed for a follow-up or for the next years survey - just by simply checking the box that stated there had been no changes since last survey. From 1952 to 1979, the Laboratory's x-ray safety record shows that there were nine x-ray related accidents at the laboratory(1). Our first x-ray accident occurred in 1958 and our last in 1979. However, we had three in as many years between 1977 and 1979. The last accident we had prompted a full scale investigation made up of a Certified Accident Investigator and two top level management personnel. It is clear that the x-ray safety program which the Laboratory eventually developed to oversee the activities of some two hundred devices was borne because of the Findings and Judgement of Needs as determined by the investigation board. To summarize, two broad points were made by that board: 1) A need exists to provide more safety features, e.g. warning lights, audible alarms, interlocks and to complete safety analysis reports, and 2) A need exists for a thorough study of the present program conducted by the Health Physics Group for controlling x-ray machines operating throughout the Laboratory. The features addressed by the study should include, at a minimum, program accountability, record keeping, published standards, surveillance program, review and approval of SOPs and independent appraisal of the program. Elements of the initial and current program are described.

Process of Writing and Publishing Standards

The Health Physics group assigned a staff member to work fulltime on the task of setting up an X-ray Device Control Office and to begin looking at those available/applicable publications which would ultimately lead to a sound

basis for Laboratory policy.

From all available publications and guidelines there were six chosen which would address all the various types of x-ray producing devices at the Laboratory.

NBS 114 was used primarily to establish that policy which would govern the safe use of the NDT (non-destructive testing) program. The NDT program uses sealed gamma-ray sources and approximately 20 non-medical x-ray devices < 10 MeV.

The second established standard which was utilized was ANSI N43.2-1977. We adopted this standard as reference when we wrote our requirements for x-ray diffraction and fluorescence analysis equipment.

Since the newly established X-ray Device Office would also be studying, reviewing, and calculating shielding requirements for existing and new facilities, it was necessary to establish safety standards for design of radiographic, fluoroscopic, industrial, and particle accelerator facilities. As the basis for writing our policy, we adopted NBS Handbooks 123 and 107, which addresses all the above x-ray devices.

To insure that diagnostic and cabinet x-ray systems be adequately addressed in our new Laboratory standard, Title 10, part 1020 of the Code of Federal Regulations, Performance Standards for Ionization Radiation Emitting Products (1020.30 and 1020.40) was used.

Lastly, the Laboratory uses a substantial number of electron microscopes in the Health and Earth Sciences groups. Therefore to address these low-energy x-ray emitting devices, the "Handbook of X-ray Safety for Electron Microscopists" was referenced and used as a guide for writing the Laboratory standard.

Initially there were several Technical Bulletins (TB) that were generated from 1979 through 1983 which outlined the safety program for intentional and incidental x-ray devices. However, by August, 1984, all Technical Bulletins pertaining to x-ray safety were replaced by an Administrative Requirement AR 3-3 with its appropriate appendices which incorporated safety requirements for analytical, industrial cabinet, industrial non-cabinet and electron microscopes(2). A user or potential user of x-ray generating devices may use this document to guide him through the process of selecting and procuring his x-ray device, receiving his X-ray safety training and to initially getting his device certified with an appropriate radiation survey. It is important to note that the purchase requests for x-ray devices from all operating groups are forwarded to the X-ray Device Control Office for radiation safety review and approval before purchasing action is taken.

TRAINING

The X-ray Device Control office provides the safety training for all x-ray operators at the Laboratory (the exception is to certified medical x-ray technicians). Training is a requirement by AR 3-3 and must be repeated by all Custodians and Authorized Operators every 4 years. Two independent x-ray safety courses are offered: one for analytical users and one for industrial users. They both provide an overview of radiation hazards, terminology, and recommended dose limits. The courses also provide the student with information about biological effects, the risks of x-ray exposure and the laboratory's X-ray Safety Program. The student receives a preliminary reading assignment and is required to take a quiz. The course is designed to be three

hours in duration but has flexibility built in due to different user requirements.

In addition to the training courses for the operators, the X-ray Device Control office provides training for its health physics surveyors. The x-ray surveyor charged with the responsibility of evaluating every operational x-ray device once/year or as required, must be thoroughly knowledgeable and trained in the difficult art of testing for compliance. The surveyors, in addition to being professional and knowledgeable, must also be consistant in surveying techniques. This is a primary objective in the surveyor training course. In addition, the instruction includes learning AR 3-3 and reviewing appropriate x-ray survey equipment and procedures. The course for the surveyor is approximately 24 class hours and includes field work at various laboratories and testing facilities. To date, the X-ray Device Office has trained nineteen surveyors with one full time x-ray surveyor being responsible for the survey program.

An X-ray Survey Manual was written in order for the Laboratory to maintain a consistant and high quality surveying technique(3). It is used as the primary training aid for the surveyor and as a field guide to insure consistancy in surveying technique. The manual was developed by the health physics group and establishes procedures for routine testing of industrial and analytical X-ray equipment for compliance with the Laboratory's AR 3-3. It contains detailed survey procedures for x-ray diffraction/fluorescence analysis systems, industrial cabinet and non-cabinet x-ray systems and electron microscopes.

STANDARD OPERATING PROCEDURES

The requirement for operating groups to write, review, and post SOP's has contributed significantly to the decline in radiation exposures and x-ray related accidents. A very positive thought process goes on during the writing of an SOP. The user group must address items that describe the normal operating procedure. The narrative must include the description and general use of the equipment. In addition, the document must describe the safety features and the hazards (not only radiological) associated with its use. Finally the SOP must describe what the operator or user should do in case of any kind of emergency.

SOP's generated by x-ray user groups are reviewed annually by their own group and then sent to the health physics group for review. Eventually, the approved SOP is posted at the control console for easy reference to personnel in the area.

CONCLUSION

Through the years since 1979, the Laboratory's X-ray Safety Program has been carefully constructed and tailored around our specific needs while still adhering to all required safety requirements of the DOE and other safety organizations. The high degree of professionalism in administering the program has gained the respect of all operating groups whom we support. The program has been highly successful and the benefits which we have enjoyed have come in the form of reduced exposures and thus far the elimination of x-ray related accidents.

REFERENCES

1. J. S. Haynie and R. H. Olsher, "A Summary of X-ray Machine Exposure Accidents at the Los Alamos National Laboratory", Los Alamos Publication Number LALP 81-32, March 1981.

2. "Administrative Requirement 3-3, X-ray Generating Devices" Los Alamos Health and Safety Manual, Chapter 1, 1986.

3. R. H. Olsher, "The Los Alamos Laboratory X-ray Survey Manual", Los Alamos Manual LA-8246-M, Feb 1980.